Development of a High-Resolution X-Ray Analyzer for Transition-Metal Oxide Research and Education

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We are constructing a multi-mirror x-ray analyzer system for synchrotron-based high-resolution x-ray emission spectroscopy. The instrument will be used to probe the metal site valence, spin polarized charge density and local magnetic ordering in transition-metal systems. In addition, it can be used to obtain light-element x-ray absorption spectra with bulk sensitivity without the need for vacuum conditions. The light-element sensitivity utilizing a hard x-ray incident beam makes the spectrometer useful for studying *in-situ* processes such as in hydrogen storage and electrochemical problems as well as high pressure spectroscopy in diamond anvil cells.

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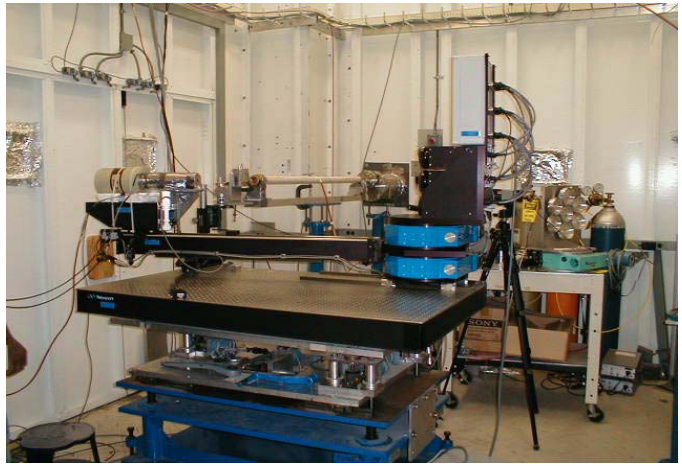

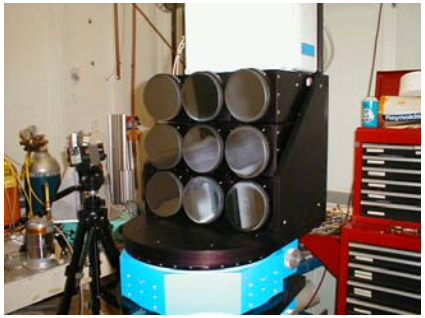

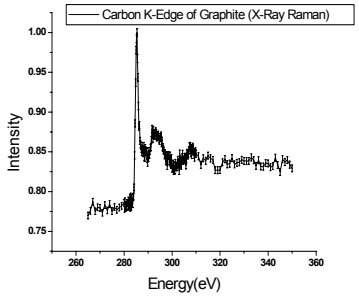

The upper and lower left panels show the full spectrometer and blow up of the analyzer array, respectively. Each of the nine x-ray focusing mirrors can be independently aligned with micro radian precision in the horizontal and vertical planes. The lower left panel show the carbon K-edge spectrum of graphite measured in energy loss mode (x-ray Raman spectrum) with a resolution of ~ 0.5 eV.

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Education:

Under this grant two graduate students are learning to conduct spin dependent absorption measurements on correlated electron systems under pressure. Also, magnetic ordering determination as a function of film thickness in manganite films is being explored. The training will open the door to unique inelastic scattering measurements which are now on the cutting edge of synchrotron based diffraction methods.

Outreach:

The development of the analyzer system was discussed in detail in our summer project for Newark area high school students (run under DMR-0209243)**.** Connections were made with standard diffraction measurements with which the students had experience in the course. The students were able to see (from pictures on the project WWW site) the construction of the analyzer system from basic design to actual field testing. This made the process of instrument development more transparent to the students. The instrument will be utilized for chemical analysis as a part of this summer program.

High school students preparing and characterizing YBCO, and presenting results.